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# LIFE HISTORIES OF *PAPILIO INDRA* AND *P. OREGONIUS*[1]

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## PAPILIO INDRA

*Papilio indra* Reakirt is usually described as an erratic flier, elusive and occurring in high mountains; and it does have such a habitat in California and Colorado. In the north it has been taken in Oregon in Baker, Grant and Jefferson Counties, at elevations of 2,000 to 7,000 feet; and in Washington in canyons along the east slope of the Cascade Mountains and in the Blue Mountains, at elevations of 500 to 6,000 feet. It has apparently not been found in British Columbia (Llewellyn Jones, 1951). This occurrence at lower elevations makes it much less elusive and more easily taken. Males may be found at wet, sandy spots along streams, sometimes in fair numbers. The females are seldom encountered, however, and then usually on flowers or flying about the food plants.

In May, 1963, the writer chanced upon a female ovipositing, and was able to capture it. It was put into a plastic ice-cream cup with some of the food plant, where it deposited 20 eggs between May 24 and 28, when it died. This has made possible a study of the early stages.

Scraps of information on the immature stages of this species have been published, chiefly to the effect that in California larvae have been found on an umbelliferous plant, *Pteryxia (Cymopteris) terebinthina* (Emmel and Emmel, 1963). The plant on which the female mentioned above was ovipositing is *Lomatium grayi,* another umbellifer. This particular specimen was taken along Kusshi Creek, in the Simcoe Mountains in Yakima County, Washington. *L. grayi* is exceedingly common on the floor of this canyon, as well as along other creeks where *indra* occurs.

There is only one brood in Washington, the adults flying at lower elevations from April to the middle of June, and at higher elevations in July. At room temperature in May the egg stage lasted 6 days and the larval period took about 18 days. Thus larvae coming from eggs laid May 24-28 were pupating June 18-20. So the insect is in the pupal stage about 11 months.

[1]The botanical nomenclature used in this paper is in accordance with that of Leroy Abrams, "Illustrated Flora of the Pacific States." Stanford Univ. Press, vol. III, 1951; vol. IV, 1960.

Food plants. — As mentioned, *indra* feeds on *Pteryxia terebinthina* in California. This plant grows in the Yakima Valley and may be a food plant here, although it does not seem to occur in the canyons where *indra* flies. Other food plants that have been mentioned include *Tauschia (Velaea) parishii* and *Cymopteris panamintensis,* both umbellifers and both found only in California (Wilson, 1961). Wilson also lists *Artemisia dracunculoides,* which is a composite and is the food plant of *P. oregonius* and *bairdi.* However, as a rule it does not grow where *indra* flies. The writer did not have an opportunity of testing *indra* larvae on this plant, but David V. McCorkle, in a letter, states that he placed sprigs of it with last-instar larvae but they would not feed on it. Emmel and Emmel (1963) credit Edwards with the statement that this *Artemisia* is a food plant but express doubts about it. Considering the evidence, it would probably be safe to say that *indra* does not feed on it. In Washington, *indra* evidently feeds primarily on *Lomatium grayi,* and sometimes on *L. triternatum* and possibly on *L. nudicaule,* both of which occur in the *indra* habitat.

## DESCRIPTION

### Papilio indra

EGG.--Spherical, slightly flattened at base if deposited on a flat surface, but not otherwise; creamy with a slight greenish tinge; surface very finely pitted. Within two days a brownish ring develops around the circumference as well as a brownish area at the micropyle. When viewed with a Stereozoom binocular at 30 X, these areas appear to be made up of irregular brownish patches just beneath the surface. Before hatching the egg becomes totally black. Diameter, 1 mm.

LARVA. FIRST INSTAR.--Head and thoracic legs shiny black; body dull black dorsally and laterally with numerous white spots of various sizes, the larger ones forming bands on segments 1, 2 and 6; the spots somewhat more numerous on 10, 11 and 12; a row of shiny black tubercles on each side of the dorsum, each one supporting one large seta and several smaller ones; other smaller spined tubercles laterad; two large tubercles on segment 1, one on each side of the dorsum; a few small setae on the ventral surface. Length, 2. 5-3 mm., width at segment 1, 0. 75 mm., tapering posteriorly.

SECOND INSTAR.--Same as first, except tubercles have lost their setae, and white areas have become yellowish. Also bright orange osmeteria have developed. Length, 5 mm.

THIRD INSTAR.--Same as second. Length, 10-15 mm.

FOURTH INSTAR.--Head with transverse black bar at front and inverted black V posteriorly; otherwise yellowish; yellowish patches on body have disappeared; tubercles not evident but yellow spots at their bases still present; otherwise velvety black except for a narrow, transverse white band on segment 1 and a wider one on the last segment; location of osmeteria marked by two yellowish spots; legs as before. Length, 20-22 mm.

FIFTH INSTAR.--When full grown, head as before; body velvety black with pinkish transverse stripe across anterior third of each segment; two ochre-yellow spots, one on each side of dorsal line, and a smaller yellow spot dorso-laterally. Pinkish stripe on body varies in width; if wide, the spots are connected with it; if narrow, they are separate; another series of spots laterally, yellow on segments 2 to 10, and white on 11; ventral area mostly dull black; thoracic legs black; prolegs black laterally, bluish ventrally; a trangular bluish area on each segment just above each proleg. Length, 35-40 mm.

PUPA.--Typical Papilio shape, except rather smooth, cephalic protuberances lacking; those on thorax less prominent than on chrysalids of rutulus, zelicaon or oregonius; at first wing covers and thorax dull green, becoming olive green; abdomen light creamy brown, mottled with darker brown; these colors persist. Length, 25 mm.

HABITS.--The newly hatched larva eats its egg shell, and at each molt the larva eats the exuvium but not the head capsule, which usually falls away. One such procedure was observed. After being quiet for nearly 36 hours, a fourth-instar larva molted. It then remained quiet for a half hour, then turned around and ate the entire exuvium. It then remained quiet again for some hours before resuming feeding.

## *PAPILIO OREGONIUS*

*Papilio oregonius* Edw. has a more northern range than *indra,* occurring from northern California into British Columbia. It seems to be limited to the area east of the Cascade Mountains. Holland (1930) says the specimen he figures, which is labelled "type," was collected by H. K. Morrison near Olympia, Wash. This is west of the Cascades, and the food plant of *oregonius* (see below) does not occur there. Also Leighton (1946) records it only from east of the mountains. So it is suspected that Morrison's specimen was mislabelled. Morrison collected in the vicinity of Mount Hood, Oregon, and he could very well have got this specimen near The Dalles, where *oregonius* does occur, and which is not far from Mount Hood.[2]

Collectors may confuse *oregonius* with *zelicaon.* Aside from the fact that the former is usually larger, the most evident distinction is the color of the abdomen. In *oregonius* the abdomen is predominantly yellow with only a narrow black stripe dorsally, a narrow, double black stripe ventrally, and, on each side, ventrolaterally, another narrow black stripe. The rest of the abdomen is yellow. In *zelicaon* the abdomen is predominantly black with one rather narrow yellow stripe down each side.

*Oregonius* is quite common along the Columbia River below Priest Rapids, about 30 miles east of Yakima, Washington. It has therefore not been difficult for the writer to study its life history. Attempts to get the females to oviposit in plastic cups, as was done with *indra,* failed. Since this is a larger species, a larger cage would be necessary. However, freshly deposited eggs and larvae in all stages were easily found on the food plant, and the life history was worked out from these.

Parasitism. — One chrysalid that had come from a larva collected when it was nearly full grown produced 72 small parasites. When discovered, these parasites were attacking other chrysalids and a full-grown larva in the same battery jar. The latter was quite irritated and was trying to shake them off. Examination with a binocular of the parasites attacking a chrysalid showed that they were not ovipositing but were feeding. A parasite would drill a small hole into the chrysalid with its ovipositor, then locate the hole with the tips of its antennae and feed for a few minutes on the fluid that was exuded. It would then locate the hole with the tip of its abdomen, insert the ovipositor and drill again, and then again feed. This process was repeated several times at the same hole.

[2]After this was written, the writer's attention was called to Edwards' statement in his Butterflies of North America, which is: "the type [of *oregonius*] was collected by Morrison near The Dalles, Oregon."

The parasites were all collected and examined, and of the 72, only 5 were males. This parasite has not been identified, but the writer (Newcomer, 1958) reported having reared *Apanteles lunatus* (Pack.), a braconid, from *P. oregonius* in 1916. This was at Wenatchee, Wash., and it is possible that these parasites are this species, which has been recorded (Essig, 1926) as parasitic on various species of *Papilio*.

Habits. — The newly hatched larva of *oregonius* eats its egg shell, and each molted larva eats the exuvium. Molting is the usual process, the skin splitting down the dorsum, the larva crawling out and detaching the head capsule with its thoracic legs. After resting for about 45 minutes the larva then turns around and eats the exuvium, holding the last remnant up in the air as it munches. This takes about five minutes, and the larva then rests again for a time before resuming normal feeding.

In two instances the exuvium was removed before the larva turned around. Not finding it, the larva again remained quiet for some time before going back to feeding on foliage. One of these larvae died a few days later. The other molted again, this time eating the exuvium, but it also died several days later. Whether this mortality was the result of not eating the exuvium cannot be said, as there was some mortality among these larvae from a disease.

Feeding is mostly on the foliage, the smaller larvae starting along the edge of a leaf, the larger ones at the tip and then devouring the entire leaf, which is linear in shape. Only the tender stems are eaten and the blossoms are avoided. Larvae are easily found on the food plant as they rest along the stems or on the leaves, not attempting to hide in any way. Pupation may occur on the larger stems or elsewhere and it is suspected that the hibernating chrysalids are in somewhat more protected places.

There are two broods of *oregonius* in Washington. Adults are flying in June and early July and again in August and September. Larvae collected about the middle of August will occasionally produce adults the same year, and these are probably from late first-brood adults. Most of them hibernate as pupae, however. Chrysalids brought in to room temperatures in March produced adults from early April until the middle of May, with three stragglers emerging June 22, July 19 and September 6.

At room temperature in August the duration of the various stages was as follows:

| | |
|---|---|
| Egg | 6 days |
| 1st instar | 3-7 days |
| 2nd instar | 4-6 days |
| 3rd instar | 4-6 days |
| 4th instar | 3-7 days |
| 5th instar | 10-16 days |

The total duration of the larval period was 30-35 days. The pupal period, for those that hibernate, is about eight or nine months; for those emerging the same year, only 10-15 days.

## DESCRIPTION

### Papilio oregonius

EGG. --Spherical, flattened at base; pearly white, becoming yellowish; surface finely pitted. A reddish ring develops around the circumference as well as a reddish areaat the micropyle. Later, the segmentation of the developing larva can be seen through the shell as grayish lines, and movement of the larva is easily observed with a Stereozoom binocular. Before hatching, the egg becomes quite black. Diameter, 1.5 mm.

LARVA. FIRST INSTAR. --Head and thoracic legs shiny black; body at first gray becoming dull black; a few yellow markings on segment 1 and a definite whitish band on 6 and 7, becoming yellowish; a row of tubercles on each side of the dorsal line, and two rows laterally; two slightly larger tubercles on segment 1. Length, 3-3.5 mm. when just emerged; becoming 5.5-6 mm. before molting; width at segment 1, 0.8 mm., tapering posteriorly; head 0.75 mm.

SECOND INSTAR. -- Head shiny black with a central yellowish mark and a lateral yellowish stripe; body brownish black to black; a yellowish band along anterior edge of segment 1; a yellowish spot laterally; a small yellowish spot antero-dorsally on segment 2; bands on 6 and 7 more pronounced and light yellow; some yellowish or brownish markings on 11 and 12; a yellowish band on 13; thoracic legs black, prolegs black with whitish pads; osmeteria developed. Length, 6 mm.; width, 1.5-2 mm.; head, 1.1 mm.

THIRD INSTAR. --Head black, yellowish stripes larger; body blackish mottled with yellow and orange; segments 6 and 7 almost wholly yellow; tubercles black and smaller in relation to body size; legs as before. Length, 8-8.5 mm.; width, 2 mm.; head, 1.75 mm.

FOURTH INSTAR. --Head creamy white with black stripes; a central yellow area; body creamy white with numerous black horizontal stripes and spots; a bright yellow spot at base of each tubercle; a lateral lengthwise yellowish stripe just above prolegs; tubercles have disappeared; thoracic legs white with black spots and claws; prolegs yellowish, each with a black spot laterally. Length, 15 mm.; width, 2.5 mm.; head, 2 mm.

FIFTH INSTAR. --When full grown, head green with median and lateral elongated black spots and two longer black stripes; a yellowish area between the stripes; ground color of body light green, ventrally somewhat bluish green; this effect caused by alternate horizontal stripes of light blue and bright green, the green being on the anterior and posterior edges of each segment, the blue in the area between; segment 1 somewhat hooded in portion containing osmeteria, with two black spots where they are located; a black transverse band anteriorly and a narrower one posteriorly; segment 2, same but anterior band partially interrupted by six yellow spots; segments 3 to 12 have black median transverse bands in the green area interrupted by six yellow spots, two near dorsum, two lateral and two ventrolateral; segment 13 with a few black markings; thoracic legs bluish green, tipped with black and a basal black spot; prolegs bluish green, each with a black spot laterally. Length, 30 to 45 mm. or even 50 mm. when stretched out; width at thorax, 9.5 mm.; head, 3.5 mm.

PUPA. --Typical Papilio shape, protuberances on head and thorax only moderate; at first light green, wing covers bluish green, remainder yellow green with two streaks of yellow along dorsum. Some individuals remain a light bluish green, but most begin to show considerable gray coloration in a day or two, some even on the day of pupation. Final color usually light grayish brown, somewhat mottled, with ventral and lateral darker stripes; protuberances also darker. Length, 30-32 mm.; width at widest point, 8-9 mm.

VARIETY. --Two of the larvae reared had all of the colors intensified. This difference appeared in the fourth instar. The head was entirely green and black with no yellow. The body was a darker green with bluish areas more restricted. The spots were orange instead of yellow. These larvae were segregated from the others. One of them was 30 mm. long when full grown. The chrysalid was a light greenish with grayish wing covers and yellow markings on the dorsum. After 11 days it produced a male adult which seemed to be typical although a little smaller than normal. The other one died in the 5th instar.

Food Plants. — The primary food plant is *Artemisia dracunculus L.* This plant is usually called *dracunculoides,* but Abrams and Ferris (1960) have made this name synonymous with *dracunculus.* The latter name was given by Linnaeus in 1753 to a plant which occurs in Siberia and Eurasia. In 1814, Pursh described *dracunculoides* from the United States, indicating by the name that he thought it looked like *dracunculus.* This plant is the tarragon of commerce, used as a spice or flavoring for vinegar and pickles, and it is raised for that purpose in Europe. In Washington and Oregon it grows inclumps sometimes three feet high, in spite of being in areas where there is practically no rain all summer, and it may be found on rocky hillsides and canyon walls. Its green color contrasts strongly with the gray of other species of *Artemisia* which may be growing nearby. Llewellyn Jones (1951) gives the food plants in British Columbia as *Artemisia* sp. and *Umbelliferae* spp. Larvae were tried on carrot and parsley leaves at Yakima but they would not eat them. Emmel and Emmel (1963), however, report that larvae would feed on fennel. Whether the species ever chooses this as a food plant is not known.

The adult butterflies seem to feed exclusively on the blossoms of various thistles. These may include *Cirsium vulgare, C. undulatum* and *C. brevifolium.* Evidently the adult food is important, as *oregonius* has been found only where there are both tarragon and thistles.

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